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SOLAR/1040-79/01

Monthly Performance Report

SADDLE HILL TRUST

LOT 77

JANUARY 1979



U.S. Department of Energy

National Solar Heating and
Cooling Demonstration Program

National Solar Data Program

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MONTHLY PERFORMANCE REPORT

SADDLE HILL TRUST
LOT 77

JANUARY 1979

I. SYSTEM DESCRIPTION

Saddle Hill Trust Lot 77 is a single-family residence in Medway, Massachusetts. Solar energy is used for preheating incoming city water. The system has an array of flat-plate collectors with a gross area of 78 square feet. The array faces south at an angle of 38 degrees to the horizontal. Air is used as the medium for delivering solar energy from the collector array to an air-to-liquid heat exchanger located in the collector air duct. Water is the medium used to transport solar energy from the heat exchanger to storage. Solar energy is stored in the basement in a 120-gallon preheat storage tank. This preheated city water is supplied, on demand, to a conventional 40-gallon domestic-hot-water (DHW) tank. When solar energy is insufficient to satisfy the hot water requirements, the gas-driven DHW heater provides auxiliary energy for water heating. The system, shown schematically in Figure 1, has two modes of solar operation.

Mode 1 - Collector-to-Storage: This mode activates when the difference between the temperature of the collector air and the temperature of the water in the preheat tank exceeds 40°F and the temperature of the water in the tank is below 140°F. Both the fan and pump go on. This mode continues until the temperature difference drops to 20°F.

Mode 2 - Storage-to-Space Heating: This mode activates when there is a demand for hot water. Hot water from the top of the preheat tank is transferred to the DHW tank to replace water removed. Simultaneously, city water is automatically supplied to the preheat tank.

II. PERFORMANCE EVALUATION

INTRODUCTION

The site was occupied in January and the solar energy system operated continuously during the month. Solar energy satisfied 17 percent of the DHW requirements. The solar energy system provided a fossil fuel energy savings of 0.46 million Btu and incurred an electrical energy expense of 0.050 million Btu.

WEATHER CONDITIONS

During the month, total incident solar energy on the collector array was 1.6 million Btu for a daily average of 671 Btu per square foot. This was below the estimated average daily solar radiation for this geographical area during January of 796 Btu per square foot for a south-facing plane with a

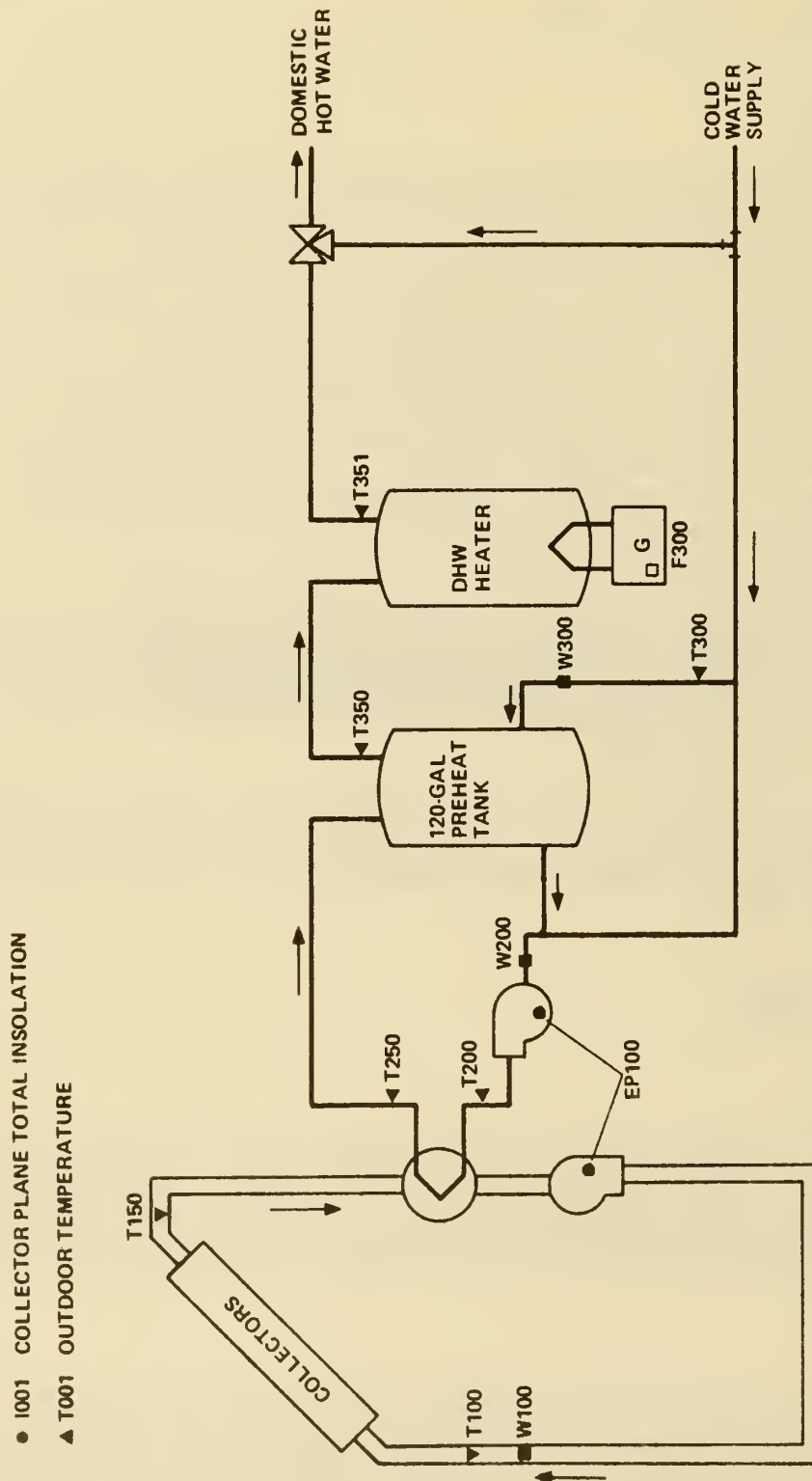


Figure 1. SADDLE HILL TRUST, LOT NO. 77, SOLAR ENERGY SYSTEM SCHEMATIC

tilt of 38 degrees to the horizontal. The average ambient temperature during January was 29°F and was equal to the long-term average for January.

THERMAL PERFORMANCE

System - During January the solar energy system performed somewhat better than expected. The expected performance was determined from a modified f-chart analysis using measured weather and the DHW subsystem load as inputs. Solar energy collected was 0.36 million Btu versus an estimated 0.21 million Btu. Solar energy used by the system was estimated by assuming that all energy collected would be applied to the load. Actual solar energy used was 0.32 million Btu. System total solar fraction was 17 percent versus an estimated 9 percent.

Collector - The total incident solar radiation on the collector array for the month of January was 1.6 million Btu. During the period the collector loop was operating, the total insolation amounted to 1.2 million Btu. The total collected solar energy for the month of January was 0.36 million Btu, resulting in a collector array efficiency of 22 percent, based on total incident insolation. Operating energy required by the collector loop was 0.050 million Btu.

DHW Load - The DHW subsystem consumed 0.32 million Btu of solar energy and 3.3 million Btu of auxiliary fossil fuel energy to satisfy a hot water load of 1.8 million Btu. The solar fraction of this load was 17 percent. Losses from the DHW subsystem were 0.49 million Btu. A daily average of 72 gallons of DHW was consumed at an average temperature of 146°F delivered from the tank.

OBSERVATIONS

A portion of the 0.49 million Btu loss in the DHW subsystem was probably used to maintain a relatively high temperature in the DHW tank.

ENERGY SAVINGS

The solar energy system incurred an electrical energy expense of 0.05 million Btu and provided a fossil fuel energy savings of 0.46 million Btu.

III. ACTION STATUS

No action is required at this time.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT SITE SUMMARY

SITE: SADDLE HILLS TRUST LOT #77, MEDWAY, MA 02053
REPORT PERIOD: JANUARY, 1979

SOLAR/1039-79/01

SITE/SYSTEM DESCRIPTION:

THE SADDLE HILL TRUST, LOT 77, SOLAR SYSTEM PROVIDES YEAR ROUND HOT WATER TO A SINGLE FAMILY DETACHED HOUSE. THE COLLECTOR IS A SOLARON 2000 FOUR PANEL AIR COLLECTOR. STORAGE IS A 120 GALLON WATER TANK. AUXILIARY HOT WATER IS PROVIDED BY A GAS DOMESTIC HOT WATER HEATER.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY
COLLECTED SOLAR ENERGY

1.623 MILLION BTU
20809 BTU/SG.FT.
0.355 MILLION BTU
4555 BTU/SQ.FT.
29 DEGREES F
N.A. DEGREES F
0.20
0.050 MILLION BTU
0.050 MILLION BTU
3.690 MILLION BTU

AVERAGE AMBIENT TEMPERATURE
AVERAGE BUILDING TEMPERATURE
ECSS SOLAR CONVERSION EFFICIENCY
ECSS OPERATING ENERGY
TOTAL SYSTEM OPERATING ENERGY
TOTAL ENERGY CONSUMED

SUBSYSTEM SUMMARY:

LOAD
SOLAR FRACTION
SOLAR ENERGY USED
OPERATING ENERGY
AUX. THERMAL ENERGY
AUX. ELECTRIC FUEL
AUX. FOSSIL FUEL
ELECTRICAL SAVINGS
FOSSIL SAVINGS

HOT WATER
1.806
17
0.321
N.A.
1.971
N.A.
3.285
-0.050
0.461

HEATING
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.

COOLING
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.

SYSTEM PERFORMANCE FACTOR:

0.524

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT
OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28, 1978,
SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT SITE SUMMARY

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REPORT PERIOD: JANUARY, 1979

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GENERAL SITE DATA:

INCIDENT SOLAR ENERGY

COLLECTED SOLAR ENERGY

AVERAGE AMBIENT TEMPERATURE
AVERAGE BUILDING TEMPERATURE
ECSS SOLAR CCNVERSION EFFICIENCY
ECSS OPERATING ENERGY
TOTAL SYSTEM OPERATING ENERGY
TOTAL ENERGY CONSUMED

1.712 GIGA JOULES
236308 KJ/SQ.M.
0.375 GIGA JOULES
51728 KJ/SQ.M.
-2 DEGREES C
N.A. DEGREES C
C.20
0.052 GIGA JOULES
0.052 GIGA JOULES
3.892 GIGA JOULES

SUBSYSTEM SUMMARY:

LOAD
SOLAR FRACTION
SOLAR ENERGY USED
OPERATING ENERGY
AUX. THERMAL ENG
AUX. ELECTRIC FUEL
AUX. FOSSIL FUEL
ELECTRICAL SAVINGS
FOSSIL SAVINGS

HOT WATER
1.905
17
0.339
N.A.
2.079
N.A.
3.465
-0.052
0.487

HEATING
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.

COOLING
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.

SYSTEM TOTAL
1.905 GIGA JOULES
17 PERCENT
0.339 GIGA JOULES
0.052 GIGA JOULES
2.079 GIGA JOULES
N.A. GIGA JOULES
3.465 GIGA JOULES
-0.052 GIGA JOULES
0.487 GIGA JOULES

SYSTEM PERFORMANCE FACTOR:

0.524

* DENOTES UNAVAILABLE DATA

@ DENOTES NULL DATA

N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT
OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28, 1978,
SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: SADDLE HILLS TRUST LOT #77, MEDWAY, MA 02053
REPORT PERIOD: JANUARY, 1979
SOLAR/1039-79/01

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	0.001	53	0.000	N	0.000	N	0.000
2	0.003	57	0.000	O	0.000	T	0.000
3	0.113	25	0.030	T	0.004		0.266
4	0.118	15	0.028		0.004		0.239
5	0.090	16	0.023	A	0.003	A	0.254
6	0.029	24	0.000	P	0.000	P	0.000
7	0.006	30	0.000	P	0.000	P	0.000
8	0.002	42	0.000	L	0.000	L	0.000
9	0.121	25	0.032	I	0.004	I	0.262
10	0.112	20	0.020	C	0.004	C	0.181
11	0.129	14	0.019	A	0.004	A	0.150
12	0.064	14	0.006	B	0.002	B	0.088
13	0.006	28	0.000	L	0.000	L	0.000
14	0.004	36	0.000	E	0.000	E	0.000
15	0.110	22	0.027		0.004		0.244
16	0.062	24	0.013		0.002		0.211
17	0.021	16	0.000		0.000		0.018
18	0.055	15	0.000		0.001		0.000
19	0.131	11	0.028		0.004		0.212
20	0.052	19	0.008		0.002		0.150
21	0.001	40	0.000		0.000		0.000
22	0.012	35	0.000		0.000		0.000
23	0.133	32	0.038		0.005		0.286
24	0.023	32	0.000		0.000		0.000
25	0.001	40	0.000		0.000		0.000
26	0.009	36	0.000		0.000		0.000
27	0.018	39	0.000		0.000		0.000
28	0.028	37	0.007		0.001		0.261
29	0.057	40	0.017		0.002		0.300
30	0.048	37	0.011		0.001		0.221
31	0.063	31	0.014		0.002		0.223
SUM	1.623	-	0.321	N.A.	0.050	N.A.	-
AVG	0.052	29	0.010	N.A.	0.002	N.A.	0.198
NBS ID	0001	N113			Q102		N111

* DENOTES UNAVAILABLE DATA.

@ DENOTES NULL DATA.

N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT COLLECTOR ARRAY PERFORMANCE

SITE: SADDLE HILLS TRUST LOT #77, MEDWAY, MA 02053 SOLAR/1039-79/01
REPORT PERIOD: JANUARY, 1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	0.001	0.000	0.000	55	0.000
2	0.003	0.000	0.000	58	0.000
3	0.113	0.103	0.033	24	0.294
4	0.118	0.100	0.031	21	0.260
5	0.090	0.078	0.025	*	0.279
6	0.029	0.000	0.000	30	0.000
7	0.006	0.000	0.000	32	0.000
8	0.002	0.000	0.000	39	0.000
9	0.121	0.108	0.035	28	0.250
10	0.112	0.095	0.024	26	0.211
11	0.129	0.111	0.023	21	0.181
12	0.064	0.040	0.008	22	0.119
13	0.006	0.000	0.000	28	0.000
14	0.004	0.000	0.000	37	0.000
15	0.110	0.094	0.028	24	0.256
16	0.062	0.043	0.014	30	0.220
17	0.021	0.001	0.000	21	0.018
18	0.055	0.003	-0.000	19	-0.000
19	0.131	0.099	0.030	19	0.228
20	0.052	0.035	0.009	27	0.178
21	0.001	0.000	0.000	40	0.000
22	0.012	0.000	0.000	36	0.000
23	0.133	0.125	0.042	37	0.315
24	0.023	0.000	0.000	*	0.000
25	0.001	0.000	0.000	41	0.000
26	0.009	0.000	0.000	35	0.000
27	0.018	0.000	0.000	41	0.000
28	0.028	0.017	0.007	42	0.264
29	0.057	0.043	0.018	45	0.311
30	0.048	0.034	0.012	39	0.250
31	0.063	0.042	0.016	34	0.260
SUM	1.623	1.171	0.355	-	-
AVG	0.052	0.038	0.011	33	0.219
NBSID	Q001		Q100		N100

* DENOTES UNAVAILABLE DATA.

@ DENOTES NULL DATA.

N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT STORAGE PERFORMANCE

SITE: SADDLE HILLS TRUST LOT #77, MEDWAY, MA 02053
 REPORT PERIOD: JANUARY, 1979
 02053SOLAR/1039-79/01

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
SUM	N.A.	N.A.	N.A.	-	-
AVG	N.A.	N.A.	N.A.	N.A.	N.A.
NBS ID	Q200	Q201	Q202		N108

* DENOTES UNAVAILABLE DATA.
 @ DENOTES NULL DATA.
 N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
HOT WATER SUBSYSTEM

SOLAR/1039-79/01

SITE: SADDLE HILLS TRUST LOT #77, MEDWAY, MA 02053
REPORT PERIOD: JANUARY, 1979

DAY OF MON.	HOT WATER LOAD MILLION BTU	SOLAR FR.OF LOAD PER CENT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FCSSIL ENERGY SAVINGS MILLION BTU	SUP. WAT. TEMP DEG F	HOT WAT. TEMP DEG F	HOT WATER USED GAL
1	0.104	40	0.000		0.049		0.082	0.000	0.018	50	142	132
2	0.090	9	0.000		0.093		0.156	0.000	0.010	47	141	115
3	0.064	11	0.030		0.069		0.115	-0.004	0.017	48	142	79
4	0.099	21	0.028		0.110		0.184	-0.004	0.037	50	148	149
5	0.104	22	0.023		0.073		0.122	-0.003	0.032	46	149	104
6	0.086	18	0.000		0.087		0.144	0.000	0.027	46	149	94
7	0.026	13	0.000		0.036		0.060	0.000	0.005	44	154	29
8	0.000	0	0.000		0.017		0.028	0.000	0.000	45	154	0
9	0.000	0	0.032		0.016		0.027	-0.004	0.000	45	154	0
10	0.000	0	0.020		0.016		0.027	-0.004	0.000	45	154	0
11	0.000	0	0.019		0.016		0.027	-0.002	0.020	45	152	33
12	0.029	36	0.006		0.037		0.061	0.000	0.041	44	146	112
13	0.097	30	0.000		0.087		0.145	0.000	0.004	51	144	38
14	0.032	8	0.000		0.044		0.074	-0.004	0.007	47	142	64
15	0.049	9	0.027		0.054		0.090	-0.002	0.026	44	143	80
16	0.068	19	0.013		0.065		0.108	-0.000	0.023	43	148	107
17	0.093	17	0.000		0.103		0.171	-0.001	0.005	46	147	65
18	0.054	7	0.000		0.061		0.101	-0.004	0.007	45	147	82
19	0.061	5	0.028		0.082		0.136	-0.002	0.005	47	144	19
20	0.010	8	0.008		0.040		0.067	0.000	0.023	44	146	62
21	0.055	20	0.000		0.061		0.102	0.000	0.020	48	139	166
22	0.112	15	0.000		0.096		0.160	-0.005	0.014	45	142	51
23	0.053	7	0.038		0.094		0.157	0.000	0.036	44	142	71
24	0.059	32	0.000		0.052		0.087	0.000	0.020	45	143	99
25	0.084	16	0.000		0.086		0.143	0.000	0.004	46	145	54
26	0.046	5	0.000		0.065		0.108	0.000	0.002	42	140	51
27	0.042	3	0.000		0.063		0.105	-0.001	0.020	44	144	181
28	0.159	10	0.007		0.134		0.223	-0.002	0.004	45	148	29
29	0.025	4	0.017		0.060		0.099	-0.001	0.024	45	146	86
30	0.077	15	0.011		0.071		0.118	-0.002	0.009	45	142	34
31	0.028	16	0.014		0.034		0.056	-0.002				
SUM	1.806	-	0.321	N.A.	1.971	N.A.	3.285	-0.050	0.461	-	-	2228
AVG	0.058	17	0.010	N.A.	0.064	N.A.	0.106	-0.002	0.015	46	146	72
NBS	Q302	N300	Q300	Q303	Q301	Q305	Q306	Q311	Q313	N305	N307	N308

* DENOTES UNAVAILABLE DATA.

@ DENOTES NULL DATA.

N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

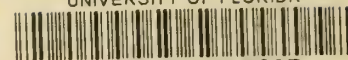
MONTHLY REPORT ENVIRONMENTAL SUMMARY

SITE: SADDLE HILLS TRUST LOT #77, MEDWAY, MA 02053
REPORT PERIOD: JANUARY, 1979
SOLAR/1039-79/01

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	19	N O T	53	55	N O T	N O T	N O T
2	44		57	58			
3	1450		25	24			
4	1509		15	21			
5	1159		16	*			
6	375		24	30			
7	73		30	32			
8	31		42	39			
9	1547		25	28			
10	1438		20	26			
11	1653		14	21			
12	821		14	22			
13	78		28	28			
14	51		36	37			
15	1404		22	24			
16	797		22	30			
17	266		16	21			
18	707		15	19			
19	1677		11	19			
20	672		19	27			
21	10		40	40			
22	153		35	36			
23	1711		32	37			
24	298		32	*			
25	9		40	41			
26	114		36	35			
27	233		39	41			
28	356		37	42			
29	732		40	45			
30	611		37	39			
31	811		31	34			
SUM	20809	N.A.	-	-	-	-	-
AVG	671	N.A.	29	33	N.A.	N.A.	N.A.
NBS ID	Q001		N113			N115	N114

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

UNIVERSITY OF FLORIDA



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